Space Weather Technical Forecast

Issued on Monday, 25 April 2022 at 13:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares (R1/R2 Radio Blackouts), with a slight chance of X-class flares (R3 Radio Blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with occasional C-class flare activity and two M1-class flares being observed at 25/0200 UTC and 25/0402 UTC. There are currently six sunspot regions on the disc, the largest and most prominent of these being AR2993 and AR2994 in the northwest. Both are large regions with some magnetic complexity, and as such these make up the majority of the flare risk at the present time, with AR2993 being responsible for the two M-flares. All other regions are smaller and simpler, although AR2996, northeast of centre disc, has shown some bipolar development, and regions near the southeast limb have given some recent (non-Earth directed) CME activity. A prolonged flare signature was observed during the 25/0200 UTC M1 flare, however no CME has been visible in the available imagery, and thus no Earth-directed CMEs were observed during the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by ACE and DSCOVR at L1, has been largely unremarkable, although with slightly elevated wind speeds suggesting perhaps a weak connection to the HSS of CH77/+. Solar wind speeds have been mostly at slightly elevated levels, varying between 420 km/s and 500 km/s. The density has been at average or below average levels (2-7 ppcc). The Interplanetary Magnetic Field strength, Bt, has been weak at 5nT or below, with the north-south component, Bz, varying weakly between +/- 5nT. The phi angle was mainly positive throughout. Geomagnetic activity was Quiet (Kp 0-2) throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) was at background levels throughout. The high energy electron flux (greater than 2MeV) has been at background to Moderate levels throughout, peaking at 358 pfu at 24/1730UTC. The associated 24 hour fluence was below the Active (1e8 integrated pfu) level, with 8.89e6 integrated pfu recorded at 25/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar Activity is currently Moderate, with a chance of further M-class flares through the period and a slight chance of an isolated X-class flare. AR2993 and AR2994, in the northwest quadrant, are the likely source for this activity but further regions may rotate round the southeast limb over the coming days.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on the 21st was forecast to pass Earth's orbit late on 24 April, with a slight chance of a glancing interaction. There remains a continuing but declining risk through day 1 (25th) that Earth may see a glancing blow from this feature. The current slightly elevated wind speeds are expected to decrease towards ambient levels through day 1 (25th) into day 2 (26th) as the effects of CH77/+ wane. No further sources of enhancement are expected during this period at the current time. Geomagnetic activity is forecast to be mostly Quiet through this period, with isolated Unsettled spells. There is a chance of Active intervals, with a very slight chance of G1, on day 1 (25th) and late on day 4 (28th).

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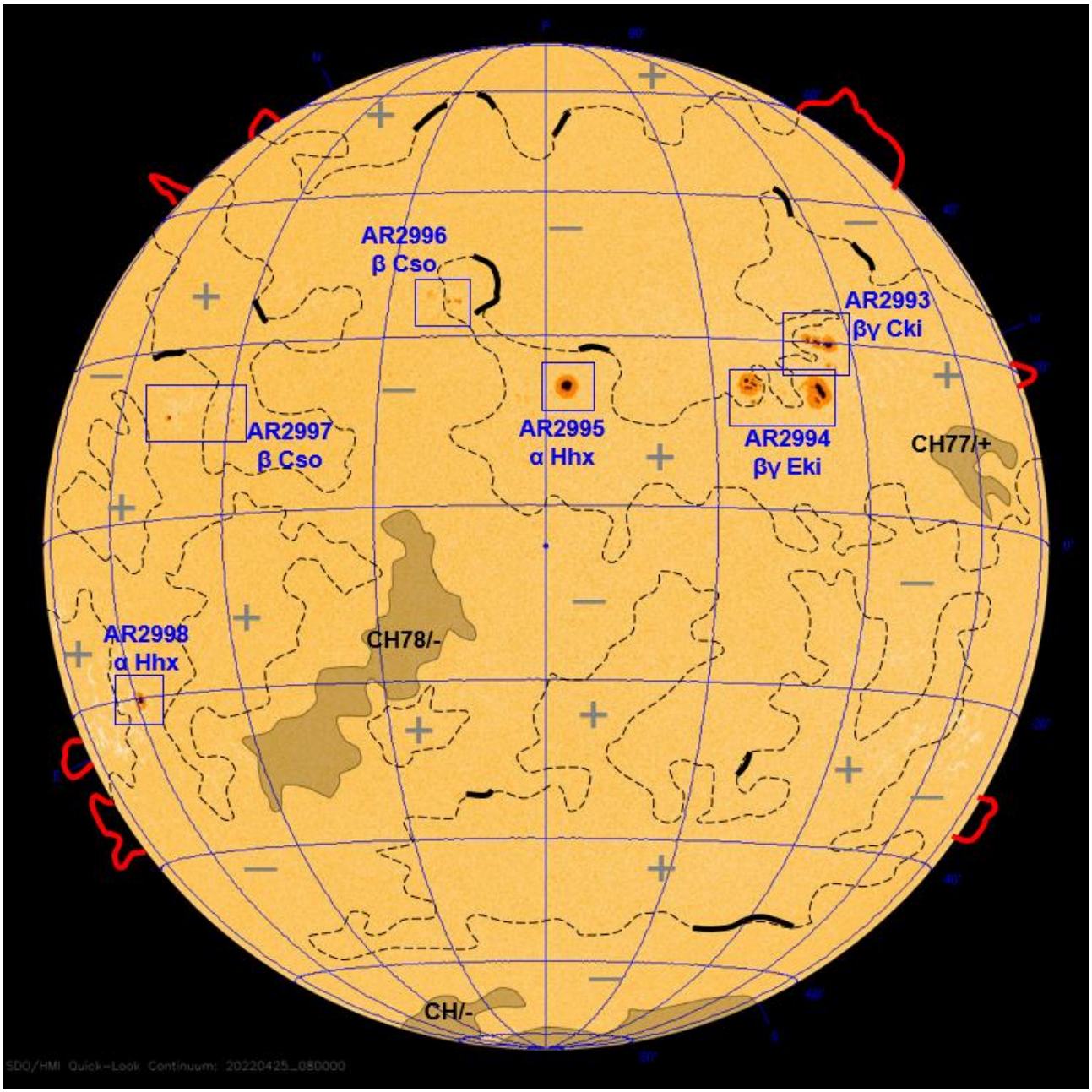
Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is at Background levels, and is most likely to remain so through the next four days. However, AR2993 and AR2994 are now transiting the northwest quadrant and together bring a slight chance of solar radiation storms reaching Earth. The high energy electron flux (greater than 2MeV) is expected to be at mainly background to moderate levels, perhaps rising slightly through the period. Electron fluence is most likely to remain below the Active (1e8 integrated pfu) threshold, with a slight chance of rising above by the end of the period.

Figure 1. Solar Analysis Valid 25/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME which left the Sun on the 21st due to an M9.6 flare from AR2993 was forecast to pass Earth's orbit late on 24 April, likely missing behind and to the north of Earth, but with a slight chance of a glancing interaction. There remains a continuing but declining risk through day 1 (25th) that Earth may see a glancing blow from this feature.

The current slightly elevated wind speeds is likely due to a weak interaction with CH77/+. This feature is now moving west of a geoeffective position and solar winds are likely to gradually decrease to ambient levels through day 1 into day 2 (25th-26th). No further sources of enhancement are currently expected during the remainder of the period. However, there is a slight chance of an enchantment towards the end of day 4 (28th) due to the CIR and HSS associated with CH78/-, but this feature isn't expected to affect earth until the 29th.

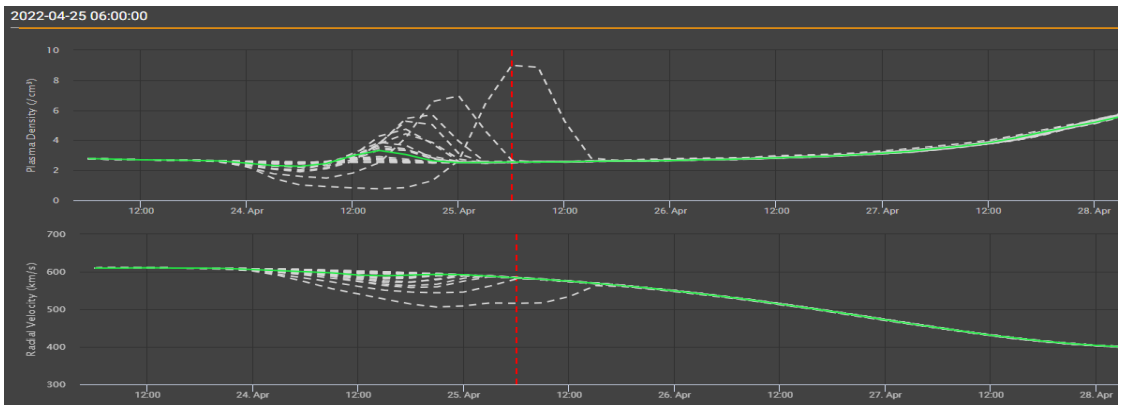
Geomagnetic activity is forecast to be mostly Quiet through this period, with isolated Unsettled spells. There is a chance of Active intervals, with a very slight chance of a G1/Minor Storm interval, in the event of any CME interaction on Day 1 (25th) or due to the early arrival of the enhancement associated with CH78/-.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
21/1245 UTC	Partial	M9.6 from AR2993	N15 E18	420	Missing	Small chance of glancing blow 24th/25th

Figure 2: Enlil Ensemble.



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Radio Blackouts - X-Ray Flares:

Solar activity has been Moderate over the past 24 hours, with two M1 flares recorded at 25/0200 UTC and 25/0402 UTC from AR2993. There has also been continued C-class flare activity, predominately from AR2993 and AR2994 in the northwest quadrant, but also from near or over the southeast limb.

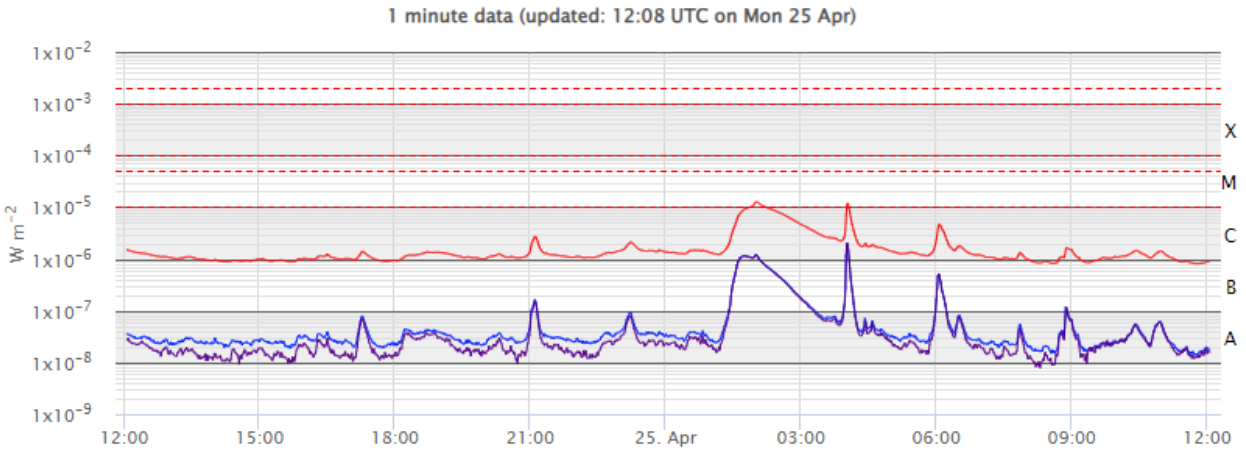
There are currently six active sunspot regions on the visible disc. AR2993 and AR2994 are close together in the northwest, with some connection between their magnetic fields. AR2993 (Cki/Beta-Gamma) is a moderately sized region, and the source of numerous M-flares in its transit. This region shows a north-south alignment in the magnetic field, which indicates some potential instability from magnetic shear. It also had a weak delta spot, which now appears to have separated into two spots. AR2994 (Eki/Beta-Gamma) is a larger region consisting of two large separate penumbral regions with some intermediate spots. The trailing region was exhibiting a small delta area, but this has also disappeared. This region has only produced 2 small M-flares since its X1.1 on the 17th, yet it still has sufficient flux for significant flares.

Three further sunspots follow in the north, but these are smaller and simpler. A further source of interest is the southeast limb, where AR2998 has rotated onto the disc. This currently appears to be a simple unipolar region, however the bright signal from over the limb on STEREO-A EUV imagery suggests the potential for further features to rotate onto the disc in the coming days.

There is a chance of M-class flares with a slight chance of X-class flares, and this risk may rise slightly in the coming days as new features rotate onto the southeast limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	60	60
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: GOES 16 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at Background levels, and is most likely to remain so through the next four days. However, AR2993 and AR2994 both bring the possibility of isolated high M-class to low X-class flares (R2-R3 Radio blackouts). As they continue to move across the northwestern quadrant there is a slight chance that solar radiation storms from any such events may be observed at Earth.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

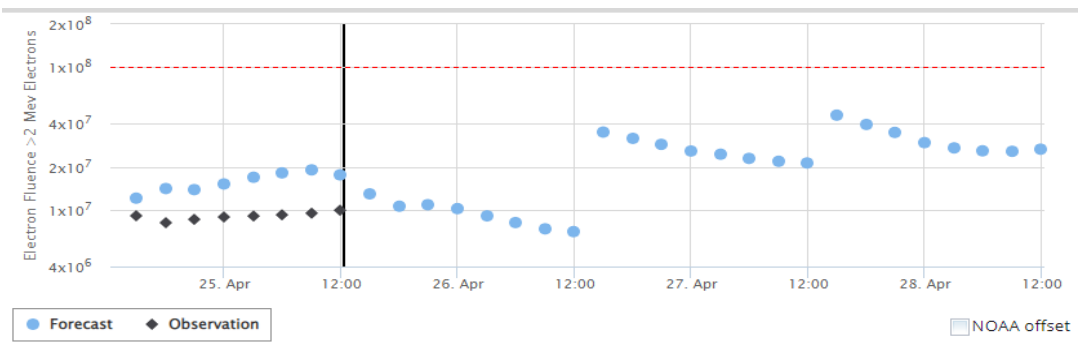
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as measured by GOES-16 at GEO is expected to be at mainly background to moderate levels, perhaps with a slight rising trend. Any glancing CME interaction on day 1 (25th) will keep electron levels suppressed in the short term. Otherwise, we appear to be experiencing weak HSS effects from CH77, but with wind speeds mostly below 500 km/s and little to no geomagnetic response, a significant rise in electron flux is considered unlikely.

The associated 24 hour fluence values are expected to remain below the Active (1e8 integrated pfu) threshold, with just a slight chance of rising above by the end of the period. REFM is currently giving reasonable guidance, suggesting a modest rise below the Active threshold.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: GOES 16 electron fluence and REFM forecast data.



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